AF/1634

PATENT

Attorney Docket No. UM-04985

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Mark A. Burns *et al.*
Serial No.: 09/751,493 Group No.: 1634
Filed: 12/28/00 Examiner: Sisson, B.
Entitled: **Microscale Reaction Devices**

TRANSMITTAL OF APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CERTIFICATE OF MAILING UNDER 37 C.F.R. § 1.8(a)(1)(i)(A)

I hereby certify that this correspondence (along with any referred to as being attached or enclosed) is, on the date shown below, being deposited with the U.S. Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Dated: March 12, 2004 By: Traci E. Light

Sir or Madam:

Enclosed herewith please find a brief in furtherence of the Notice of Appeal mailed on January 12, 2004 regarding the above-identified patent application. Please find a check enclosed in the amount of **$165.00** to cover the cost to file a brief in support of an appeal under 37 CFR § 1.17(c).

The Commissioner is hereby authorized to charge payment of any fees associated with this communication or credit any overpayment to Deposit Account No. **08-1290**. **An originally executed duplicate of this transmittal is enclosed for this purpose.**

Dated: March 12, 2004

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APPELLANTS BRIEF

APPEAL NO.:

ATTENTION: Board of Patent Appeals and Interferences
Commissioner for Patents and Trademarks
Washington, D.C. 20231

CERTIFICATE OF MAILING UNDER 37 CFR § 1.8(a)

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the U.S. Postal Service with sufficient postage as first class mail in an envelope addressed to the: Assistant Commissioner of Patents, Washington, D.C. 20231, on March 12, 2004.

By: Traci E. Light

Sir/Madam:

This Brief is in furtherance of the Notice of Appeal mailed on January 12, 2004.

The fees required under 37 CFR § 1.17(c) are dealt with in the accompanying TRANSMITTAL OF APPEAL BRIEF.

This Brief is transmitted in triplicate. 37 CFR § 1.192(a)

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This Brief contains these items under the following headings and in the order set forth below in accordance with 37 CFR § 1.192(c):

I. REAL PARTY IN INTEREST

The current assignee, the Regents Of The University Of Michigan, 3003 South State Street, Ann Arbor, Michigan 48109-1280, is the real party in interest.

II. RELATED APPEALS AND INTERFERENCES

There are no related applications on appeal or in an interference.

III. STATUS OF CLAIMS

The present application (09/751,493) was filed on 12/28/00, containing Claims 1-12. A first Final First Office Action was mailed November 02, 2001. Subsequently, amended Claims 1 & 8 and new Claims 13-20 were placed on the record via a first Request For Continued Examination. A second Final First Office Action was mailed July 3, 2002. Amendments to Claims 1, 5, 8 & 13 were filed as a second Request For Continuing Examination and properly placed on the record. Subsequently, a first Non-Final Office Action was mailed January 16, 2003. In response, Claims 1, 8 and 13 were amended. The Examiner reasserted rejections in a third Final Office Action mailed on August 12, 2003. The Applicants timely filed a Notice Of Appeal.

Applicants, therefore, appeal the Final Office Action dated August 12, 2003 rejecting claims currently of record numbered as 1-20.

The claims, as they now stand, are set forth in Appendix A (attached at Tab 1).

IV. STATUS OF AMENDMENTS

All amendments in the case have been entered.

V. SUMMARY OF THE INVENTION

The present invention relates to microfabrication of microscale devices and reactions in microscale devices, and in particular, movement of biological samples in microdroplets through microchannels to initiate biological reactions. (pg 11 ln 18-20).

The present invention contemplates microscale devices, comprising linked (*i.e.*, in liquid communication) microdroplet transport channels and reaction chambers using a surface-tension-gradient mechanism in which discrete microdroplets are differentially heated and propelled through the channels. (pg 11 ln 23-25). In a preferred embodiment, these elements are microfabricated from silicon and glass substrates. (pg 12 ln 26-29). Since all of the components are made using conventional photolithographic techniques, multi-component devices can be readily assembled into complex, integrated systems. (pg 17 ln 1 - pg 20 ln 3).

The present invention contemplates a variety of silicon-based, microdroplet transport channel-containing devices. In one embodiment, the device comprises: i) a microdroplet transport channel connected to a reaction region, and ii) a series of heating elements arrayed along the transport channel. (See Figure 5A; pg 27 ln 21 - 25) In another embodiment, the present invention contemplates a system comprising: i) a microdroplet; ii) a first and second microdroplet transport channel connected to a reaction region, and iii) a series of heating elements arrayed along the transport channel. (See Figure 1B and 1C). In another embodiment, the device comprises: i) a first housing portion comprised of silicon (200), ii) a microdroplet transport channel (100) connected to a reaction region, iii) a second housing portion (300) bonded to said first housing portion thus creating an assembled housing; and iv) a series of heating elements arrayed along the transport channel. (See Figure 2; pg 13 ln 21-28). Preferably, the transport channels are etched in silicon and layered to provide either

electrical insulation (*i.e.,* for example, see Example 1 pg 23 ln 21 - pg 24 ln 19; Figure 5B showing alternating silicon oxide and silicon nitride layers) or improve hydrophilicity (*i.e.,* for example, see Example 2 pg 24 ln 20 - pg 25 ln 25 for application of Rain-X Antifog®). The microdroplet preferably comprises an organic material that includes, but is not limited to, proteins, lipids and nucleic acids (pg 8 ln 9).

VI. ISSUES

There is one rejection on appeal:

1) Whether Claims 1-20 are obvious under 35 U.S.C. § 103(a) over U.S. Patent No. 5,922,591 To Anderson *et al.* in view of U.S. Patent No. 5,587,128 To Wilding *et al.* and U.S. Patent No. 3,965,047 To Yamaguchi *et al.*

VII. GROUPING OF CLAIMS

Each claim stands alone. Each claim has distinct limitations and must be considered independently. Unfortunately, the Examiner has not considered them independently and has merely lumped them together.

Independent Claim 1 specifies a device comprising a microdroplet transport channel in a silicon substrate connecting to a reaction region and having an array of heating elements. Most importantly, the claim specifies a particular configuration of these heating elements, i.e. that they "are configured so as to provide differential heating." This claim is further limited by the dimensions of the transport channel; specifically, the transport channel has a depth between 0.35 and 50 μm and a width between 50 and 100 μm.

Dependent Claim 2 further specifies that the heating elements comprise aluminum. Dependent Claims 3 and 5, respectively, further specify that the transport channel may be treated with a hydrophilicity-enhancing compound and/or may have a first silicon oxide layer, a silicon nitride layer and second silicon oxide layer. Dependent Claim 4 further specifies that the substrate comprises silicon. Dependent Claim 6 further specifies that the substrate has a second microdroplet transport channel. Dependent Claim 7 further specifies that the first and second microdroplet transport channels are etched in the substrate.

Independent Claim 8, on the other hand, specifies a system comprising a microdroplet, first and second microdroplet transport channels in a silicon substrate that are connected to a reaction region and arrays of heating elements along both first and second microdroplet transport channels. This claim is distiguished from Claim 1 by reciting "a microdroplet" and "a second transport channel". Most importantly, Claim 8 specifies a particular configuration of the heating elements in the context of the microdroplet element. Specifically, Claim 8 requires that "said series of heating elements are configured so as to provide differential heating of said microdroplet by said heating elements." This claim is further limited by the dimensions of the transport channel; specifically, the transport channel has a depth between 0.35 and 50 μm and a width between 50 and 100 μm. Dependent Claims 9 and 10, respectively, further specify that the microdroplet comprises an organic material which may be a protein, lipid or nucleic acid. Dependent Claims 11 and 12, respectively, further specify that the substrate contains etched first and second transport channels and that the substrate comprises silicon.

Finally, Independent Claim 13 specifies a device comprising first and second housing portions that are bonded and aligned to create an assembled housing, wherein the first housing

portion has a microdroplet transport channel connected to a reaction region. This claim is distinguished from both Claim 1 and Claim 8 by reciting that the device is assembled from two separate portions, wherein only the first portion comprises any microdroplet transport channels. On the other hand, Claim 13 shares (with Claims 1 and 8) the requirement of a specific configuration of the heating elements "so as to provide differential heating." This claim is further limited by the dimensions of the transport channel; specifically, the transport channel has a depth between 0.35 and 50 μm and a width between 50 and 100 μm. Claim 13 also requires that the second housing portion consist of silicon, quartz or glass. Dependent Claim 14 further specifies that the heating elements comprise aluminum. Dependent Claims 15 and 17, respectively, further specify that the transport channel may be treated with a hydrophilicity-enhancing compound and/or may have a first silicon oxide layer, a silicon nitride layer and second silicon oxide layer. Dependent Claim 16 further specifies that the substrate comprises silicon. Dependent Claim 18 further specifies that the substrate has a second microdroplet transport channel. Dependent Claim 19 further specifies that the second transport channel has a second array of heating elements. Dependent Claim 20 further specifies that the first and second microdroplet transport channels are etched in the substrate.

Because each of the Independent claims have different limitations, they do not stand or fall together. Rather, they need to be evaluated separately.

VIII. ARGUMENT

Only a single rejection is at issue (discussed below). However, there are numerous fundamental procedural errors made by the Examiner that provide grounds for reversing the Examiner. First, as noted above, the Examiner has not independently considered the claims. Second, the Examiner has given certain claim limitations no patentable weight and simply ignored them. Third, the Examiner has resorted to non-analogous art. These procedural errors are discussed prior to a discussion of the Examiner's improper obviousness rejection.

A. The Claims Have Not Been Independently Considered

The Examiner rejects Claims 1-20 as a group. The Examiner has not independently considered each of the claims. This can be seen by the complete absence of any discussion in the Final Office Action (dated 8/12/03) of the particular limitations of Claim 13. At no point does the Examiner discuss the two part assembly of the housing. At no point does the Examiner indicate that the cited art contains this feature. This fundamental procedural error means that there is no proper rejection of Claim 13 (and claims depending on Claim 13). Without further analysis, the Examiner's rejection of these claims cannot stand.

B. The Examiner Has Ignored Elements Of The Claims

It is fundamental black letter patent law that claim elements cannot be ignored by the Examiner. And yet, the Examiner makes it clear that no patentable weight is being given to the requirement in ALL three independent claims that the heating elements be "configured so as to provide differential heating." Indeed, the Examiner makes the following assertion (Office Action dated 8/12/03, page 4): "None of the claims specify that the fluid is propelled as a result of differential heating."

While it is true that the claims are device and system claims - not method claims - and thus do not have a "propelling fluid" method step, ALL of the independent claims require a *configuration* that will achieve fluid movement. Thus, it is not enough for the Examiner merely to find heating elements in a reference. The Examiner must find a teaching that the heating elements are *configured* in a manner so has to cause differential heating. Each independent claim makes it clear that part of this configuration involves using a "series of heating elements arrayed along said microdroplet transport channel."

Particular attention must be given Claim 8 (and dependent claims), which has - as an element - a microdroplet. The Board is asked to note that the claim requires configuration of the heating elements "so as to provide differential heating of said microdroplet by said heating elements." This language clearly links the heating elements to movement of the microdroplet. The Examiner is not free to ignore this specified arrangement of the claim elements. And yet, this is precisely what the Examiner has done. On this basis alone, the rejection of claims 1-20 cannot stand.

C. The Examiner Relies On Non-Analogous Art

As noted above, all of the independent claims specify microdimensions for the transport channel. Clearly, the field involved is microfabrication. And yet, the Examiner cites large scale industrial heating devices in the combination of art used as a basis for the rejection. Specifically, the '047 patent (by Yamaguchi et al.) teaches large scale industral heating: "The heat generating members formed in accordance with the priniciples of the invention are useful for heating large volumes of a fluid . . ." ('047 patent, col. 4, lines 6-8). The '047 patent makes it clear that the industrial device is intended to work at extreme temperatures (". . . heated to about 1000^0C. with the aid of heat generating members produced

in accordance with the principles of the invention.") ('047 patent, col. 2, lines 65-68). It is clear that the '047 patent is non-analogous art.

A determination of obviousness is based upon numerous factors, including whether the art cited by the examiner is analogous art. *In re Gorman*, 933 F.2d 982 (Fed. Cir. 1991). If a cited reference is not analogous art, it has no bearing on the obviousness of a patent claim. *Jurgens v. McKasy*, 927 F.2d 1552 (Fed. Cir. 1991). Under the two step method for determining whether a reference is analogous art, an examiner must consider whether the reference is 1) within the field of the inventor's endeavor and 2) if not, whether the reference is reasonably pertinent to the particular problem with which the inventor was involved.

A reference can be considered to be within the field of the inventor's endeavor if the art cited and the appellants disclosure have essentially the same function and structure. *In re Deminski*, 796 F.2d 436 (Fed. Cir. 1986). A finding of analogous art cannot be based, however, on a mere conclusion that the appellants disclosure and the cited art are within the same industry, there must be an asserted factual basis for a finding of analogous art. *In re Clay*, 966 F.2d 656 (Fed. Cir. 1992)

A reference can be reasonably pertinent to a particular problem if it is one that, due to the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem. If the cited art has the same purpose as disclosed in the application, an inventor may well have been motivated to consider it in making his invention; if the cited art does not have the same purpose, an inventor would be less motivated to consider it. *In re Clay*, 966 F.2d 656 (Fed. Cir. 1992).

Clearly, in this case, an inventor attempting to solve relatively low temperature heating issues on a microscale level would not turn to large scale industrial heating devices which

work at extreme temperatures. In short. there is no motivation to consider furnaces when one is attempting to move microdroplets down a microdroplet transport channel.

For this reason alone, the Examiner must be reversed. The Examiner relies on non-analogous art in the combination cited as a basis for the rejection. This cannot stand.

D. Claims 1-20 Are Not Obvious

Applicants submit that the Examiner has not properly established obviousness of the rejected claims. The Examiner's (conclusory) statement at issue is:

> It would have been obvious to one of ordinary skill in the art at the time the invention was made to have combined the aspect of an array of heating elements in a micro-channel with micro-scale channels and reaction chambers, fluid receiving means and organic materials ... In view of the well-developed nature of the devices and the reactions, the ordinary artisan would have had a reasonable expectation of success.

Final Office Action Mailed 08/12/03, ¶ 11. The Examiner's conclusion is unsupported by any facts or evidence. Indeed, the Examiner fails to make a *prima facie* case of obviousness because (1) there is no motivation to combine the references, (2) *In re Keller* and *In re Merck & Co.* do not provide an excuse for avoiding the threshold inquiry of whether the art should be combined in the first place; and (3) the Examiner improperly uses the Applicants' specification as a teaching.

1. There Is No *Prima Facie* Case Of Obviousness

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the reference(s) themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference.[1] Second, there must be a reasonable expectation of success. Finally, the prior art reference (or

[1] The MPEP § 2143.01 specifically provides that "THE PRIOR ART MUST SUGGEST THE DESIRABILITY OF THE CLAIMED INVENTION" (emphasis in original).

references when combined) must teach or suggest all the claim limitations. *In re Vaeck*, 947 F.2d 488, 20 USPQ.2d 1438 (Fed. Cir. 1991); and *MPEP* § 2142; Establishing A *Prima Facie* Case Of Obviousness. The Board is reminded that if ONLY ONE of the above requirements is not met, then a *prima facie* case of obviousness does not exist. In the present Appeal, the Applicants clearly demonstrate that the Examiner's rejection does not meet these criterion.

a. There Is No Motivation For Combining The References

The Examiner has offered no substantive basis for combining the references. The Examiner's conclusory rejection (*supra*) is not based upon: i) any specific teachings of Anderson *et al.*, Wilding *et al.*, or Yamaguchi *et al.*, or ii) evidence provided by an Examiner's affidavit.

The Examiner cannot produce the required evidence because none of the cited references contain the required motivation. First, as noted above, the Examiner's use of Yamaguchi is entirely improper because it is non-analogous art; by definition, an inventor would not be motivated to resort to the teachings of non-analogous art. Second, the Examiner essentially admits the remaining prior art is not even directed at the same goal and does not address the problem. Specifically, the Examiner admits that Anderson *et al.* "do[es] not disclose that the heating elements are arranged in an array format such that fluid transport is achieved." *Final Office Action* Mailed 08/12/03, ¶ 7. The Applicants agree. Thus, Anderson *et al.* does not provide any teachings, either explicit or implicit, to suggest or motivate one skilled in the art to array heating elements along a microdroplet channel.[2]

[2] Anderson *et al.* advocates achieving fluid transport by differential pressures.

Similarly, the Examiner asserts that, to the extent Wilding *et al.* teaches heating elements, they are not for the purpose of fluid transport: "The intent of the heating elements in the disclosure is for the denaturation of nucleic acid, not for fluid transport." *Final Office Action* Mailed 08/12/03, ¶ 9. Indeed, Wilding teaches the use of multiple heating elements for regulating the temperature of a reaction chamber. (Wilding, Column 8, lines 28-31). Wilding addresses the problem of sample flow with pumps - not with differential heating. (Wilding, Column 18, lines 1-6). Since Wilding is not seeking to differentially heat microdroplets to cause their movement, there is certainly no motivation for combining the Wilding reference with art that uses other fluid movement means.

It appears that the Examiner's conclusory statements about motivation amount to nothing more than a personal opinion. Clearly, none of the references cited by the Examiner provide any evidence to provide motivation for modification to include heating elements arrayed along a microdroplet transport channel.

b. The Examiner Reliance On *In re Keller* And *In re Merck* & Co. Is Misplaced

In a response to the Office Action Mailed 01/16/03, Applicants argued that the Examiner was not free to combine art without first determining whether the combination was justified in the first place. In the Final Office Action, the Examiner summarily rejected this fundamental tenet of patent law:

> In response to applicant's argument against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See In re Keller, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); In re Merck & Co., 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Final Office Action Mailed 08/12/03, ¶ 12.

The Examiner's reliance on *In re Keller* and *In re Merck & Co.* is misplaced. These cases do not provide an excuse to avoid the threshold determination of whether a combination of art is proper. Applicant submits that the references cannot be considered collectively until the Examiner points to some *evidence* to support combining those references. The purpose behind this requirement is to prevent the Examiner from using the invention itself and hindsight reconstruction to defeat the patentability of the invention. The Federal Circuit has repeatedly made this clear:

> To prevent the use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner to show a motivation to combine the references that create the case of obviousness. In other words, the examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed.

See In re Rouffet et al., 149 F.3d 1350, 47 USPQ2d 1453 (Fed. Cir. 1998). It is readily apparent that the law of *In re Rouffet* requires the Examiner to present soundly reasoned arguments based upon the substance of the cited references.[3] Moreover, the law does not regard the Examiner as one skilled in the art. *See In re Rijckaert*, 28 USPQ2d 1955 at 1956 (Fed. Cir. 1993)("[T]he examiner's assumptions do not constitute the disclosure of the prior art."); *See id.* at 1957 ("[W]hen the PTO asserts that there is an explicit or implicit teaching or suggestion in the prior art, it must indicate where such a teaching or suggestion appears."). Indeed, the Federal Circuit has made it clear that "[b]road, conclusory statements regarding the teachings of multiple references, standing alone, are not 'evidence.'" *In re Dembiczak*, 175 F.3d 994, 999, 50 USPQ2d 1614 (Fed. Cir. 1999).

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[3] *Accord Ex parte Clapp*, 227 USPQ 972 (Bd. Pat. App. & Inter. 1985) (stating that the examiner must present convincing line of reasoning supporting rejection).

Applicant submits that the Examiner has not provided a sound explanation for combining these references as required by the law in *In re Rouffet*. What the Examiner has provided are unsupported and conclusory statements.

c. The Examiner Improperly Uses The Applicants' Own Teachings In The Specification.

Importantly, the use of the cited art cannot be rendered in hindsight by incorporating the teachings of the Applicants' specification. (MPEP 2145 X(A)); and *Heidelberger Druckmaschinen v. Hantscho Commercial Products*, 30 USPQ2d 1377, 1380, 21 F.3d 1068 (Fed. Cir. 1994)("The motivation to combine references cannot come from the invention itself.").

As explained above, none of the cited references can be interpreted to disclose heating elements arrayed along a microdroplet transport channel. It stands to reason, therefore, that the Examiner necessarily must have obtained this element by reading the Applicants' disclosure. This is an impermissible approach during the examination of patent applications. A patent application must be examined only by what was known prior to the filing of the application, and not what is contained within the application. Thus, the rejection of the claims under 35 U.S.C. § 103 cannot stand.

2. Even If Improperly Combined, All Elements Are Not Taught

The lack of a *prima facie* case is more than sufficient to justify reversing the Examiner. However, it should be noted that even if the references are improperly combined, all elements are not taught. First, as pointed out at the beginning, the Examiner is completely silent regarding the two portion housing limitation of Claim 13. Nothing in the art has been shown to teach this element. Second, as emphasized above, each of the independent claims requires a configuration involving a series of heating elements "arrayed along said

microdroplet transport channel." (Claim 1). A commonly used definition of the term "along" is ". . . in a line in parallel with the length or the direction of . . ." *Merriam-Webster Dictionary On-Line.* This is consistent with the teachings of the specification (see Figures 3, 5 and 6 and associated text). At no point has the Examiner shown that the cited art teaches such a configuration. The Yamaguchi reference does not teach microdroplet transport channels and is non-analogous art. The heating elements of Wilding *et al.* are strictly limited to reaction chambers:

> The device may further include a system for **thermally cycling the contents of the reaction chamber** ...

Wilding et al., col 12 ln 34 -37 [emphasis added],

and,

> ... the reaction chamber advantageously facilitates **heat transfer to the reaction chamber contents** ... from a heater positioned near the substrate ...

Wilding et al., col 12 ln 46 - 50 [emphasis added],

and,

> As discussed above, **reaction chamber sections may be heated** by means of an electric element integrated in the substrate below the sections, which can mate with electrical elements of the appliance. Alternatively, an optical laser may be used to **heat the reaction chamber sections** through a glass cover disposed over the substrate.

Wilding et al. col. 23 ln 48 - 53. [emphasis added]. Finally, the Examiner admits that Anderson *et al.* "do[es] not disclose that the heating elements are arranged in an array format such that fluid transport is achieved." *Final Office Action* Mailed 08/12/03, ¶ 7. Clearly, the art lacks this feature. Therefore, combining the art merely results in a combination that lacks this feature.

E. Conclusion

Appellants submit that, with due consideration to all these factors discussed above, the patentability of the claims is evident. First, the Examiner has made several procedural errors - each one being sufficient to warrant reversal (without even reaching the alleged merits of the obviousness rejection). Second, Anderson *et al.*, Wilding *et al.*, and Yamaguchi *et al.* are improperly combined. The Examiner has not satisfied the *prima facie* legal standards to properly establish obviousness. Moreover, these cited references do not teach all the elements of the Applicants' claimed embodiment; for example, heating elements arrayed along a microdroplet transport channel. As such, the Board is respectfully requested to reverse the Examiner's erroneous rejection of Claims 1-20 and pass all pending claims to allowance.

Respectfully submitted,
MEDLEN & CARROLL, LLP

Dated: 3/12/2004

By: _____
Peter G. Carroll
Reg. No.: 32,837

Attorneys for Appellant

IX. APPENDIX A: CLAIMS INVOLVED IN THE APPEAL

1. A device comprising:

    i) a microdroplet transport channel in a silicon substrate, said channel having a depth between 0.35 and 50μm, having a width between 50 and 1000μm, and connecting to a reaction region; and

    ii) a series of heating elements arrayed along said microdroplet transport channel, wherein said series of heating elements are configured so as to provide differential heating.

2. The device of Claim 1, wherein said heating elements are comprised of aluminum.

3. The device of Claim 1, wherein said transport channel is treated with a hydrophilicity-enhancing compound.

4. The device of Claim 1, wherein said substrate comprises silicon.

5. The device of Claim 1, wherein said microdroplet transport channel further comprises a first silicon oxide layer, a silicon nitride layer, and a second silicon oxide layer.

6. The device of Claim 1, further comprising a second microdroplet transport channel in said substrate.

7. The device of Claim 6, wherein said first and second transport channels are etched in said substrate.

8. A system comprising:

   i) a microdroplet;

   ii) first and second microdroplet transport channels in a silicon substrate, said channels having a depth between 0.35 and 50μm, having a width between 50 and 1000μm, and connecting to a reaction region; and

   iii) a series of heating elements arrayed along said first and second transport channels, wherein said series of heating elements are configured so as to provide differential heating of said microdroplet by said heating elements.

9. The system of Claim 8, wherein said microdroplet comprises organic material.

10. The system of Claim 9, wherein said organic material is selected from the group consisting of proteins, lipids, and nucleic acids.

11. The system of Claim 8, wherein said first and second transport channels are etched in said substrate.

12. The system of Claim 11, wherein said substrate comprises silicon.

13. A device comprising:

i) a first housing portion comprising silicon;

ii) a microdroplet transport channel in said first housing portion, said transport channel having a depth between 0.35 and 50μm, having a width between 50 and 1000μm, and connecting to a reaction region;

iii) a second housing portion bonded to and aligned with said first housing portion thus creating an assembled housing, wherein said second housing portion is selected from the group consisting of silicon, quartz or glass; and

iv) a series of heating elements in said assembled housing arrayed along said fluid transport channel, wherein said series of heating elements are configured so as to provide differential heating.

14. The device of Claim 13, wherein said heating elements are comprised of aluminum.

15. The device of Claim 13, wherein said transport channel is treated with a hydrophilicity-enhancing compound.

16. The device of Claim 13, wherein said transport channel comprises silicon.

17. The device of Claim 16, wherein said transport channel further comprises a first silicon oxide layer, a silicon nitride layer, and a second silicon oxide layer.

18. The device of Claim 13, further comprising a second microdroplet transport channel in said first housing.

19. The device of Claim 13, further comprising a second series of heating elements arrayed along said second transport channel.

20. The device of Claim 13, wherein said first and second transport channels are etched in said first housing.